

Appendix C

A STREAMER MODEL

C.1 The effects due to streamers

Due to the structural nature of the solar corona it is important to consider the effects on the K-corona due to coronal inhomogeneities. In this regard consider a streamer imbedded in a spherically symmetric isothermal corona. The model streamer considered has the following structure as depicted in figure (C.1). The streamer is of thickness d and the extremes of the streamer, namely, RT and UV are equidistant from the solar center C and are inclined at an angle ϵ to the plane of the solar limb. Within the streamer the electron number density is enhanced by a factor f_s and the thermal electron temperature is T_s . From figure (C.1) the expressions for X_1 (=FV) and X_2 (=FT) are given by equation (C.1).

$$\boxed{\begin{aligned} x_1 &= \rho \times \tan(\epsilon) - \frac{d/2}{\cos(\epsilon)} \text{ and} \\ x_2 &= \rho \times \tan(\epsilon) + \frac{d/2}{\cos(\epsilon)} \end{aligned}} \quad (C.1)$$

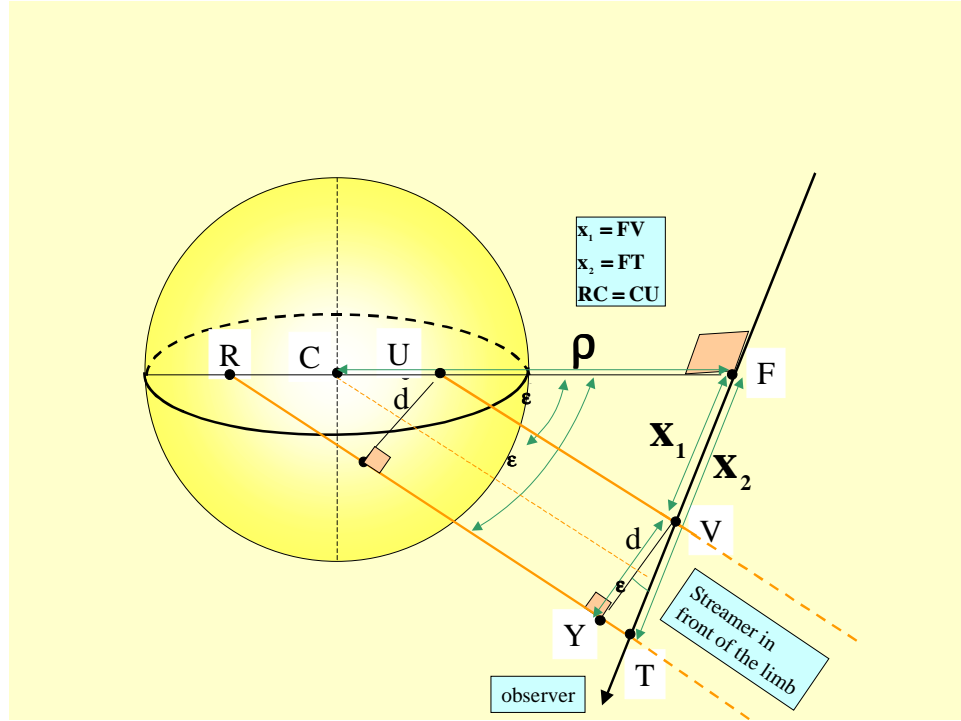


Figure (C.1). Model streamer of thickness d in front of the solar limb with an electron density enhancement by a factor f_s and thermal electron temperature T_s .

And in the streamer model considered the electron density is enhanced by a factor f_s in the region between x_2 and x_1 along the line of sight. The incorporation of the effect due to the streamer in the code, as described in section (B.12), is as follows.

1. For specified values for d, ρ and ϵ calculate x_1 and x_2 .
2. In the x -integration (integration along the line of sight) if x lies between and including x_1 and x_2 then multiply the electron number density by a factor f_s and substitute T_s for T where f_s and T_s are specified.

3. Perform the x -integration by trapezoidal composite rule instead of the Hermite polynomial expansion. This was found to be necessary in order to pick up sufficient x -values in the region $[x_1 \text{ and } x_2]$. Since the Hermite polynomial expansion considered in the code is of twentieth order there may not be sometimes any x -values in the region $[x_1 \text{ and } x_2]$.
4. The x -integration is substituted by the following commands

;CALCULATE FIRST INTEGRAL PARAMETERS AND THE VALUE

```
function calculate_first_integral_value $ ,a,lambda,rho,hermite_12,weights_12,w,T
```

```
;FIRST INTEGRAL BOUNDS
```

```
a1=-6.0 ;lower bound at - 6.0 solar radii
```

```
b1=+6.0 ;upper bound at +6.0 solar radii
```

```
n1=120.0 ;region divided into 120 equal intervals
```

```
h1=(b1-a1)/n1
```

```
f1=fix(n1)
```

```
sum_x_t=dblarr(f1+1)
```

```
sum_x_r=dblarr(f1+1)
```

```
total_sum_x_t=0.0
```

```
total_sum_x_r=0.0
```

```
intensity=dblarr(2,1)
```

```

for h=0,f1 do begin
    x=a1+h*h1
    final_sum_2=calculate_second_integral_value $
        (a,lambda,rho,hermite_12,weights_12,x,w,T)
    if (final_sum_2(0,0) eq 999999999999.9999) then begin
        intensity=final_sum_2
        goto, terminate_1
    endif
    sum_x_t(h)=final_sum_2(0,0)
    total_sum_x_t=total_sum_x_t+sum_x_t(h)
    sum_x_r(h)=final_sum_2(1,0)
    total_sum_x_r=total_sum_x_r+sum_x_r(h)
endfor

```

Although x-integration need to be considered in the interval $[-\infty, +\infty]$ it is sufficient to restrict the integration to $[-6.0, +6.0]$ solar radii due to the rapid falloff in the electron number density.

Consider a streamer model as depicted by figure (C.1) with a streamer width (**d**) of 0.5 solar radii, density enhancement factor (**f_s**) of 4.0 within the streamer and assuming the thermal electron temperature (**T_s**) within the streamer to be equal to isothermal coronal temperature (**T**) for the rest of the corona. Figure (C.2) shows the effect of streamers, at angles (**ε**) – **45.0** degrees (front of the limb) and + **45.0** degrees (behind the limb) to the limb of the solar corona, on the K-coronal spectrum.

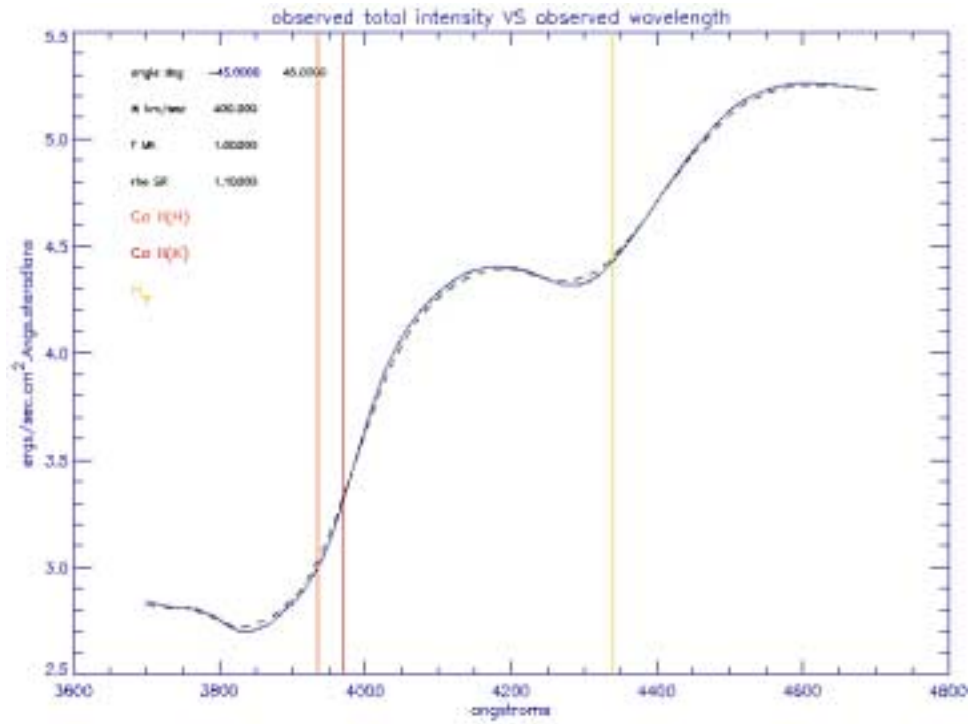


Figure (C.2). Plot to show the effect of streamers on the K-coronal spectrum with $d=0.5$ SR, $f_s=4.0$, $T_s=T=1.0$ MK and at angles $\epsilon=-45.0$ and $+45.0$ degrees.

Although the two streamers considered in figure (C.2) are symmetric about the plane of the solar limb the asymmetry in the two theoretical spectra is due to the fact that the streamers scatter through different angles in reaching the observer. Figure (C.3) illustrates this point.

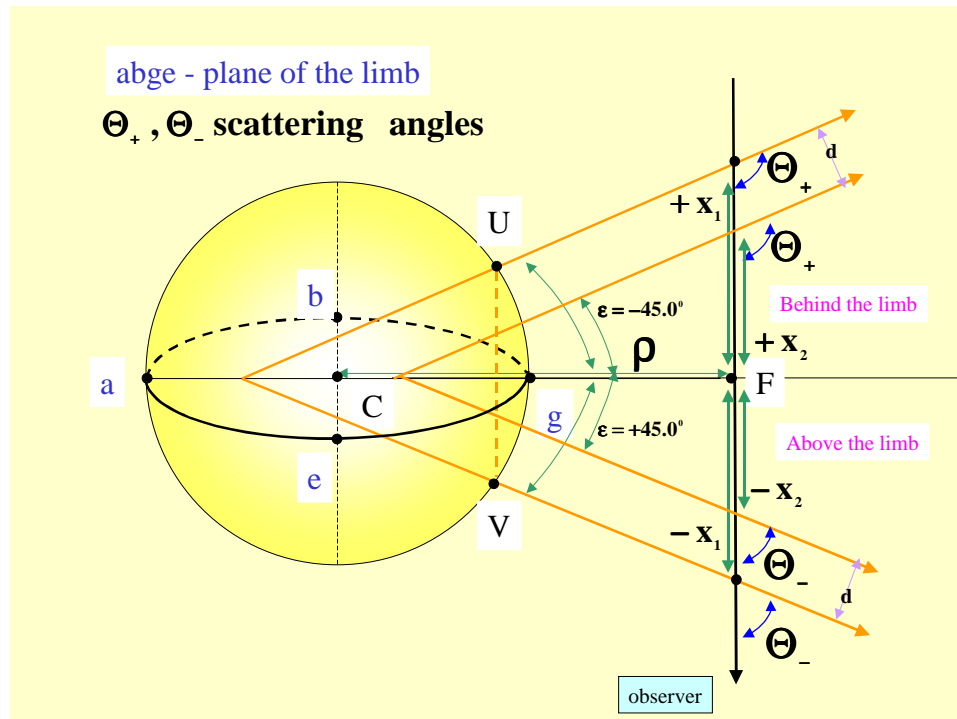


Figure (C.3). Model streamers of similar dimensions at -45.0 and -45.0 degrees above and below the plane of the solar limb, respectively.

Figure (C.4) shows the effect of streamers, at series of angles (ϵ) in front and behind the plane of the solar limb, on the K-coronal spectrum. As per the streamer model considered the intensity of the K-coronal spectrum decreases as the location of the streamer moves away from the plane of the solar limb.

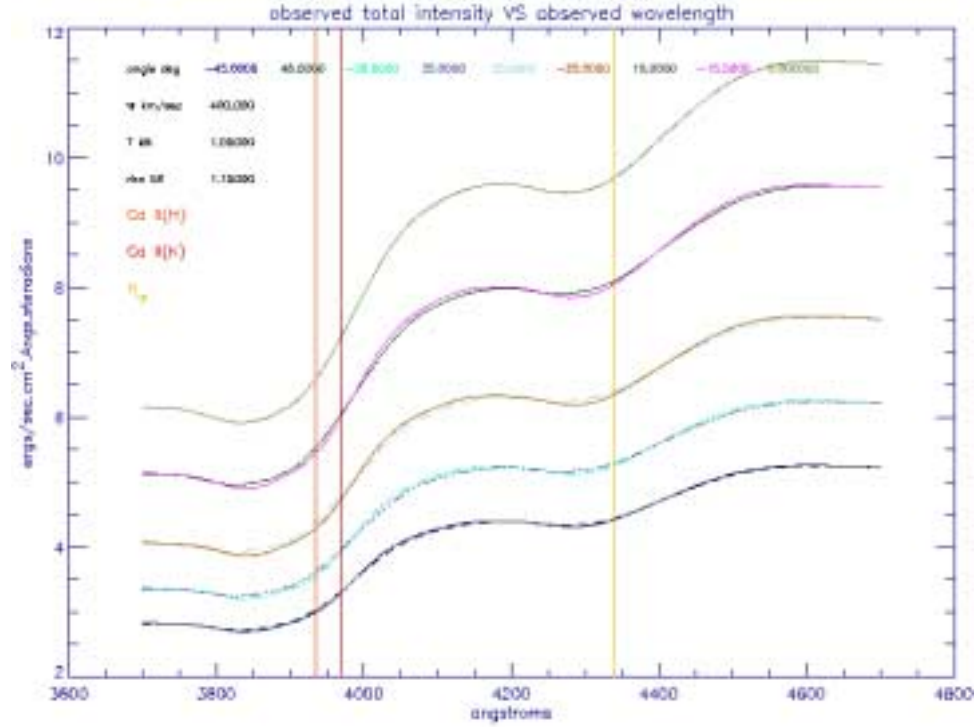


Figure (C.4). Plot to show the effect of streamers on the K-coronal spectrum with $d=0.5$ SR, $f_s=4.0$, $T_s=T=1.0$ MK and spread over various angles ϵ .

The following figures (C.5) to (C.6) show the effect on the wind and temperature sensitive intensity ratios $I(4233)/I(3987)$ and $I(4100)/I(3850)$, respectively, by a streamer of the shape depicted by figure (C.1) and with a streamer width (d) of 2.0 solar radii, density enhancement factor (f_s) of 4.0 within the streamer and assuming the thermal electron temperature (T_s) within the streamer to be equal to isothermal coronal temperature (T). The horizontal lines show the intensity ratio for a given solar wind speed, isothermal coronal temperature and line of sight in the absence of streamers. The curves are the corresponding ratios with a streamer of the shape depicted in figure (C.1)

but at various angles in front and behind the solar limb. This is only one example of a streamer model.

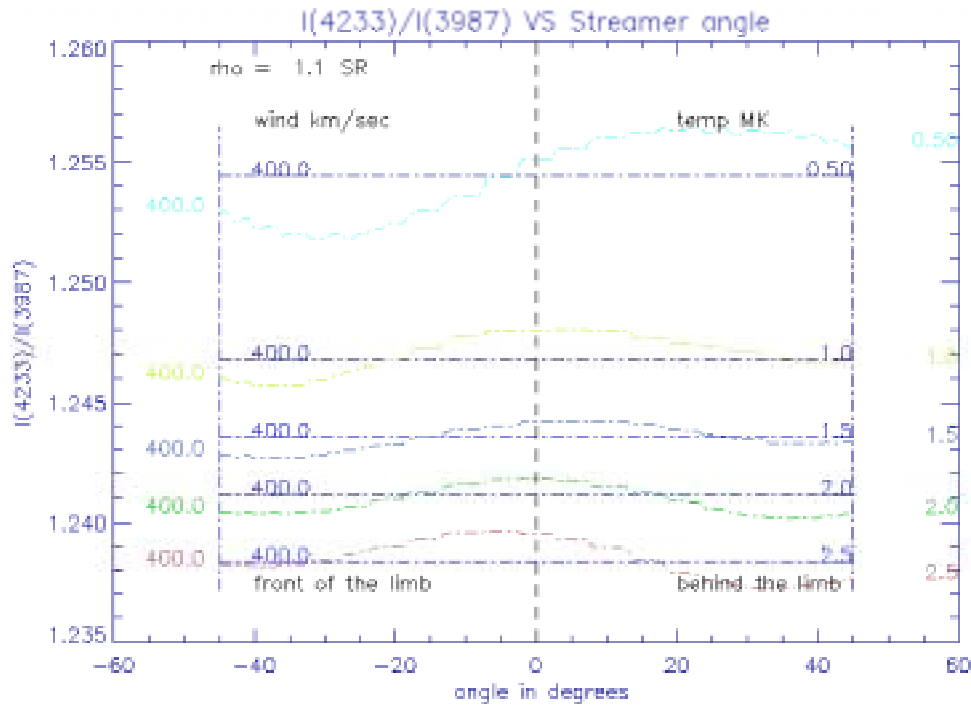


Figure (C.5). Effects by streamers on the ratio $I(4233)/I(3987)$ for $W=400$ km/sec and $\rho=1.1$ SR. The horizontal lines show the intensity ratio for a given solar wind velocity of 400.0 km/sec and line of sight at 1.1 solar radii, and for different isothermal coronal temperature in the absence of streamers.

From figure (C.5) it is apparent that even for a simple streamer structure shown in figure (C.1) the wind sensitive intensity ratio can differ from the ratios predicted by models that do not consider streamer structures. The horizontal lines in figure (C.5) are from models that do not consider any streamer structures. A similar occurrence could also be seen for the temperature sensitive intensity ratio as shown in figure (C.6).

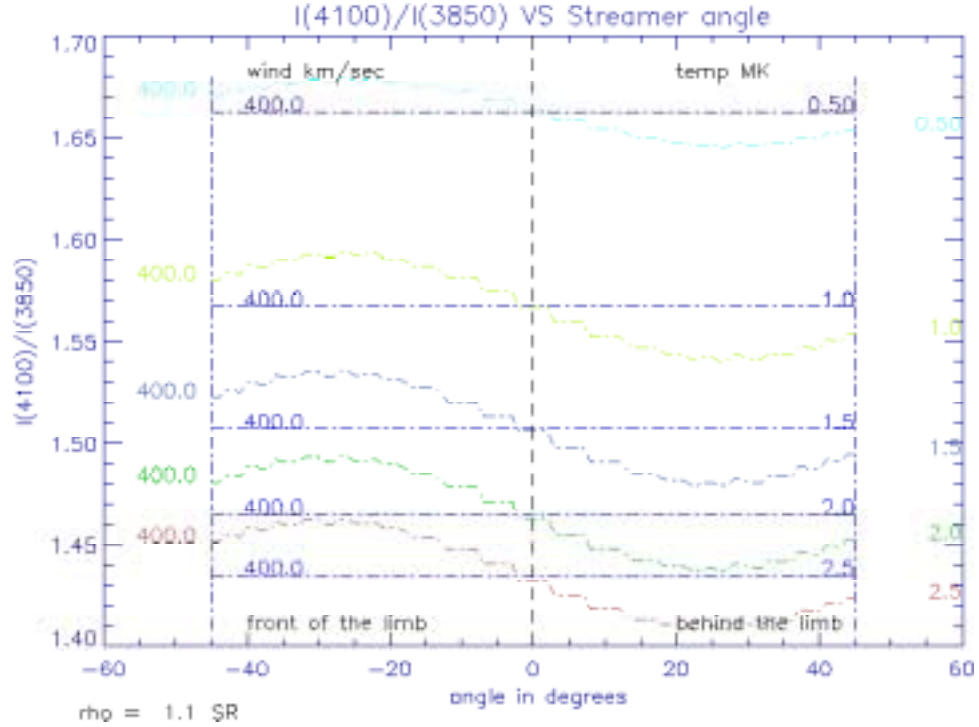


Figure (C.6). Effects by streamers on the ratio $I(4100)/I(3850)$ for $W=400$ km/sec and $\rho=1.1$ SR. The horizontal lines show the intensity ratio for a given solar wind velocity of 400.0 km/sec and line of sight at 1.1 solar radii, and for different isothermal coronal temperature in the absence of streamers.

Unfortunately it is not an easy task to incorporate realistic streamer models simply by observing an eclipse. Nevertheless figure (C.5) and figure (C.6) are examples that show the effect on the wind and the temperature sensitive intensity ratios by streamers.